

**Friday 15 June 2012 – Afternoon**

**GCSE TWENTY FIRST CENTURY SCIENCE  
CHEMISTRY A**

**A171/02** Modules C1 C2 C3 (Higher Tier)

Candidates answer on the Question Paper.  
A calculator may be used for this paper.

**OCR supplied materials:**  
None

**Other materials required:**

- Pencil
- Ruler (cm/mm)

**Duration:** 1 hour



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

**INFORMATION FOR CANDIDATES**

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

- 1** The Earth’s early atmosphere was probably formed by volcanic activity. It consisted mainly of carbon dioxide and water vapour. The table shows the most important changes that have taken place in the Earth’s atmosphere from early times to the present day.

gas	approximate percentage (%) in early atmosphere	percentage (%) in atmosphere 500 years ago	percentage (%) in today’s atmosphere
nitrogen	very small	78	78
oxygen	0	21	21
carbon dioxide	85	0.03	0.04
water vapour	10	between 1 and 5	between 1 and 5

- (a)** Explain how the changes in the percentages of carbon dioxide and oxygen shown in the table took place.



The quality of written communication will be assessed in your answer.

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..... [6]

(b) The atmosphere today may contain pollutant gases. Steps are being taken to reduce the amount of pollutant gases released into the air.

The flue gases from power stations contain the acidic gas, sulfur dioxide.

Sulfur dioxide can be removed by reacting it with calcium hydroxide.

(i) This makes a solid product and water.

Name the solid product.

..... [1]

(ii) Complete this sentence about the reaction.

The reaction between calcium hydroxide and sulfur dioxide happens because

calcium hydroxide is ..... [1]

(iii) Another process uses limestone (calcium carbonate) to remove sulfur dioxide.

This reaction makes a solid product and carbon dioxide.

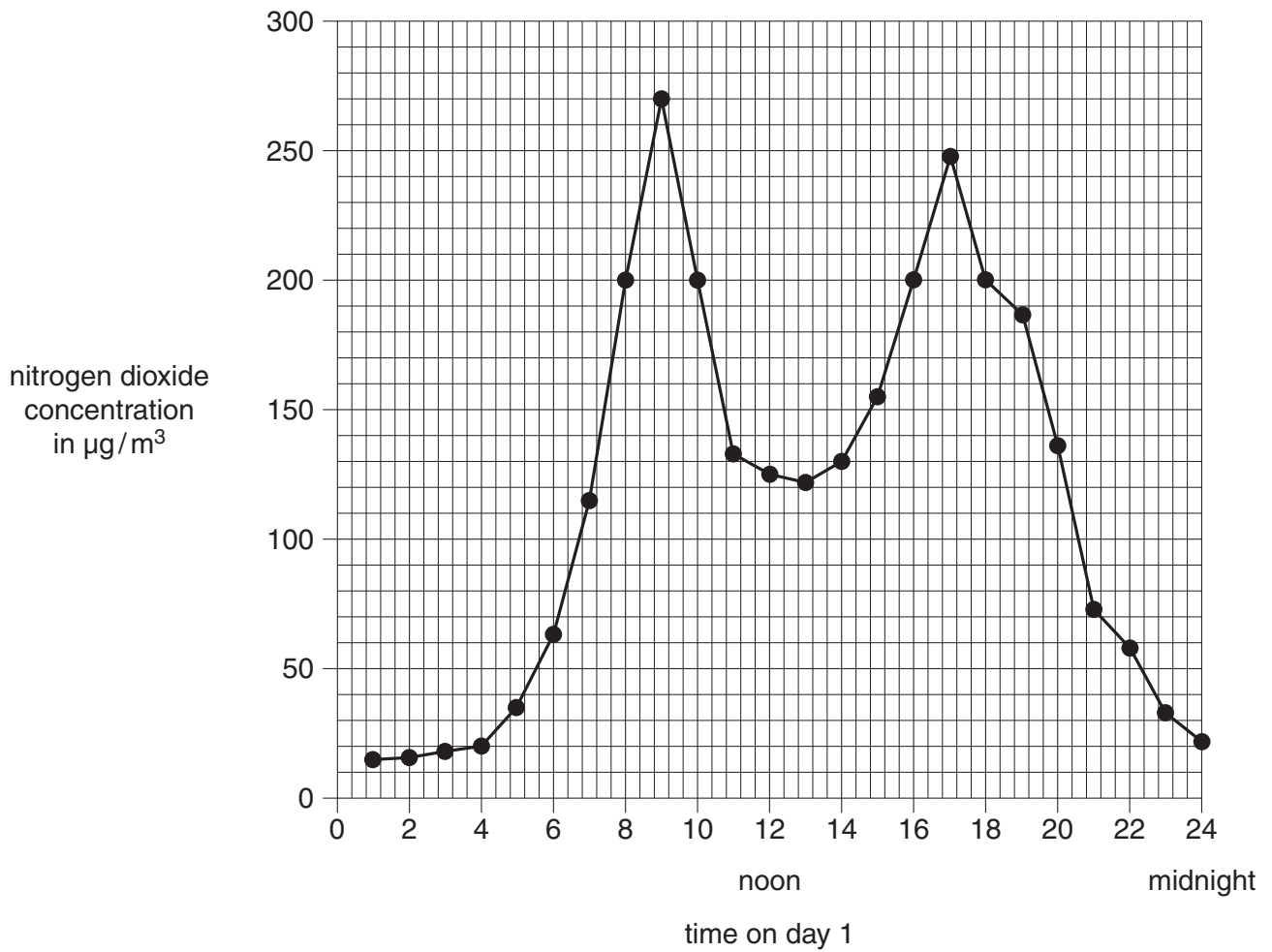
Suggest a disadvantage of using calcium carbonate rather than calcium hydroxide.

.....  
..... [1]

[Total: 9]

- 2 Scientists investigated the nitrogen dioxide concentration in the air next to a city road over a 24 hour period on **day 1**.

Their results are shown in the graph.



- (a) The World Health Organisation (WHO) has suggested limits for nitrogen dioxide concentrations.

These are  $200 \mu\text{g}/\text{m}^3$  for a one-hour average exposure and  $40 \mu\text{g}/\text{m}^3$  for an annual average exposure.

Some students are discussing these limits as they look at the graph.

**Ali**  
The concentration is lower than  $40 \mu\text{g}/\text{m}^3$  for several hours on this day.

**Beth**  
The concentration is higher than  $200 \mu\text{g}/\text{m}^3$  for only part of the day.

**Cal**  
The concentration stayed higher than  $200 \mu\text{g}/\text{m}^3$  for more than one hour.

**Dan**  
People only stay near the city road for a short time during the time of highest concentration.

**Ed**  
The graph only shows measurements for one day.

- (i) Whose comment shows that one of the WHO limits has been exceeded?

answer ..... [1]

- (ii) Whose comment shows that no conclusion can be made about the other WHO limit from the evidence in this graph?

answer ..... [1]

(b) The scientists also counted the number of vehicles travelling along the road on **day 1**.

These results are shown in the tables.

<b>Hour of the day</b>	1	2	3	4	5	6	7	8	9	10	11	12
<b>Number of cars</b>	2	3	5	9	31	54	242	461	584	472	287	277

<b>Hour of the day</b>	13	14	15	16	17	18	19	20	21	22	23	24
<b>Number of cars</b>	275	285	363	458	566	449	372	163	64	36	22	12

Use information from the tables to explain the shape of the graph.

.....

.....

.....

.....

.....

..... [3]

(c) The scientists repeated this investigation on **day 2**.

The table shows the measurements they took at 9 am.

<b>Sample number</b>	1	2	3	4	5	6	7	8	9	10
<b>Nitrogen dioxide concentration in <math>\mu\text{g}/\text{m}^3</math></b>	281	308	285	282	284	286	283	285	284	285

(i) The measurement for **sample 2** is much higher than the other measurements.

What should the scientists consider when deciding whether or not to include this value in their calculation of the best estimate?

.....

.....

.....

..... [2]

- (ii) The scientists use these results to work out the best estimate of the nitrogen dioxide concentration at 9 am on **day 2**. They calculate a concentration of  $284 \mu\text{g}/\text{m}^3$ .

Look at the nitrogen dioxide concentration at 9 am on the graph for **day 1**.

Suggest reasons for the difference between the two values.

.....  
..... [1]

- (d) Electrically-powered cars are already used in many cities.

These cars may **not** be the ideal solution to air pollution problems.

Put ticks (✓) in the boxes next to the **three** statements that, when taken together, give the best explanation for this.

Fossil fuels are burned to generate mains electricity.

Fossil fuels are non-renewable and will one day run out.

As fossil fuels are burned, pollutant gases are given off.

Electric cars give out pollutant gases as they are used.

Electric cars have batteries that are charged from the mains electricity supply.

The batteries in electric cars have to be replaced every few years.

[3]

[Total: 11]

3 A company plans to make a new rope for sailing boats.

The new rope must be strong and quite stretchy.

Scientists working for the company test ropes made from five polymers, **A**, **B**, **C**, **D** and **E**.

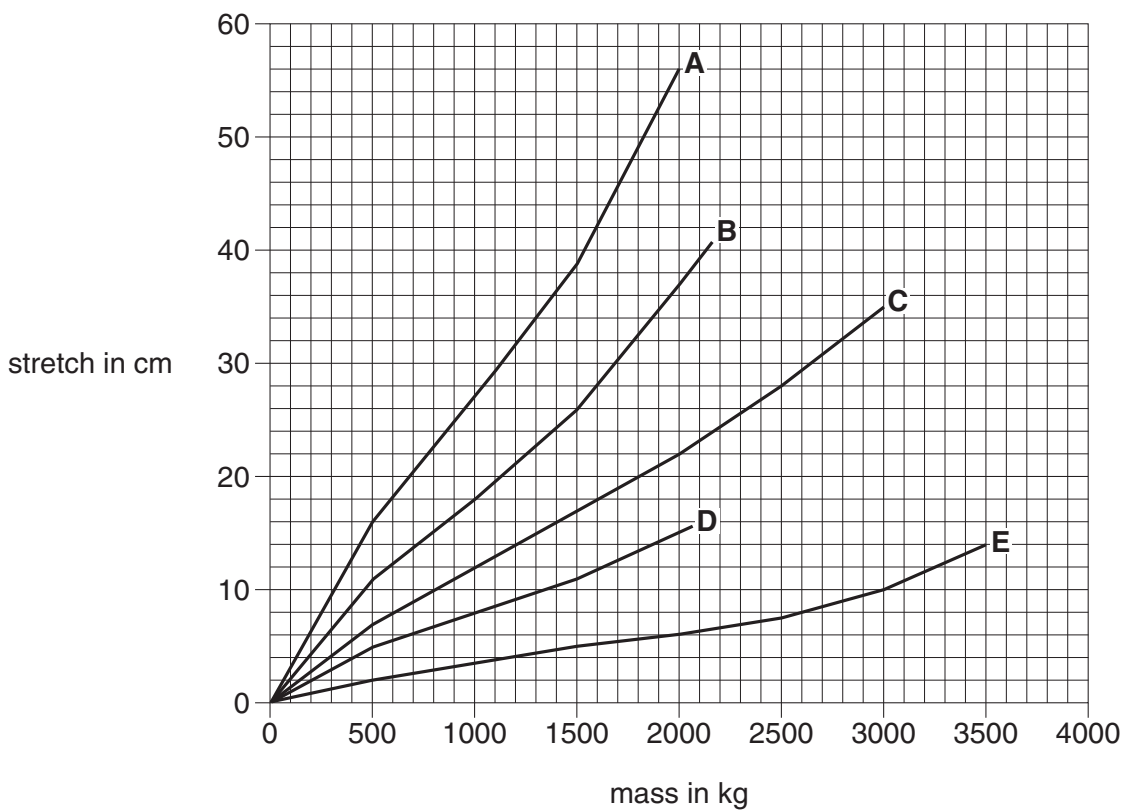
They want to know which is the best polymer to use.

They measure how much each rope stretches as a load is applied to it.

They do this until the rope breaks.

Each rope has the same thickness and the same length.

Their results are shown in the graph. Each line ends when the rope breaks.





- (a) The scientists make sure that all factors except the type of polymer are identical for each test.

Explain why.

.....  
.....  
..... [2]

- (b) Look at the graph.

Is there a link between the stretchiness of the ropes and their strength?

Explain your answer.

.....  
.....  
..... [2]

- (c) **A** and **E** are different forms of the **same** polymer.

What differences in the structure of the polymers could have caused these differences in their properties?

Put ticks (✓) in the boxes next to the **two** correct statements.

Polymer **E** has less plasticizer than polymer **A**.

Polymer **E** has cross-linked chains but polymer **A** does not.

Polymer **E** is less crystalline than polymer **A**.

Polymer **E** has shorter chains than polymer **A**.

Polymer **E** has fewer cross-links than polymer **A**.

[2]

(d) Ropes made of **different** polymer molecules have different breaking strengths.

Use ideas about forces and molecules to explain why.

.....  
.....  
..... [2]

(e) The company chooses to make the new rope from polymer **C**.

Suggest why they use this polymer rather than any of the others.

.....  
.....  
.....  
.....  
..... [3]

[Total: 11]

4 Crude oil is a mixture of hydrocarbons.

(a) Which elements are present in a hydrocarbon?

..... [1]

(b) The hydrocarbons in crude oil are used to make fuels, lubricants and raw materials for chemical synthesis.

Some of the following statements about the hydrocarbons in crude oil are true and some are false.

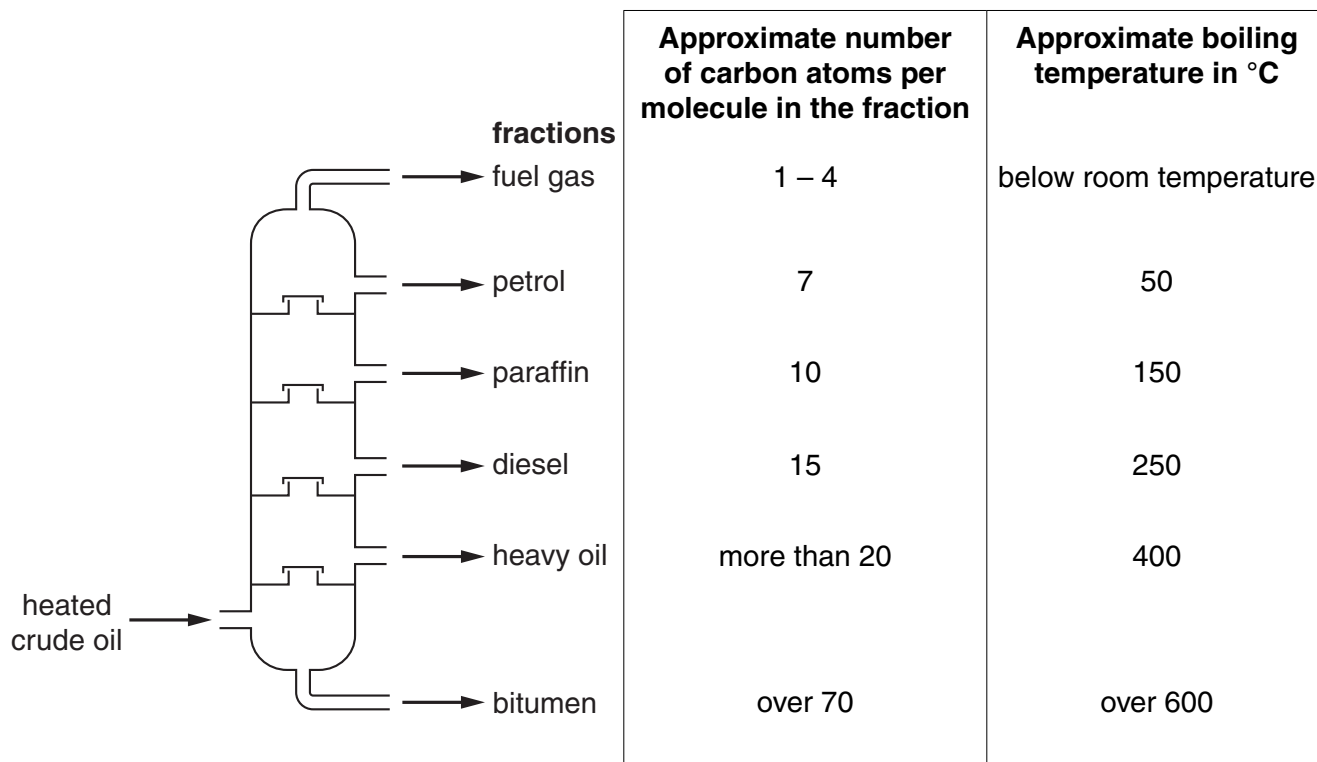
Put a tick (✓) in the correct box next to each statement to show whether it is **true** or **false**.

	True	False
There are hydrocarbon molecules of many different sizes.		
Most of the hydrocarbon molecules are used for chemical synthesis.		
All of the hydrocarbon molecules can be burned as fuels.		
All of the hydrocarbon molecules can be polymerised.		

[2]

(c) The hydrocarbon molecules in crude oil boil at different temperatures.

In a refinery the hydrocarbons in crude oil are separated into fractions.



Use the information opposite to describe the link between the size of the molecules in each fraction and the temperature at which the fraction boils.

Explain this pattern using ideas about forces, molecular size and the way in which molecules are arranged in liquids and gases.



The quality of written communication will be assessed in your answer.

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..... [6]

[Total: 9]



(b) The life cycle of a plasticized PVC product that is used in people's homes includes these four stages.

- A making the plasticized polymer
- B packaging the product
- C using the product
- D disposing of the product

(i) At which stage, **A, B, C** or **D**, would **members of the public** be most at risk from plasticizers?

answer ..... [1]

(ii) At which stage, **A, B, C** or **D**, would **workers** be most at risk from plasticizers?

answer ..... [1]

(c) To make a personal decision about whether or not the risks involved in the use of plasticizers are acceptable, what information would you need?

Put ticks (✓) in the boxes next to the **two** best answers.

The probability that you may suffer harmful effects from the use of plasticizers.

The benefit of using plasticizers in PVC.

How much PVC is manufactured in the UK each year.

What harmful effects plasticizers can cause at the concentrations involved.

The chemical formulae of the plasticizers that are used.

Which manufacturers make plasticized PVC.

[2]

[Total: 10]

6 Sodium chloride (common salt) has many uses.

It is used in the food industry and to treat icy roads in winter.

(a) Salt mined from underground contains rock fragments and grit.

Most of this salt is used to treat icy roads in winter.

(i) Suggest why this salt is particularly useful to treat icy roads

.....  
..... [1]

(ii) Suggest why this salt is **not** used in the food industry.

.....  
..... [1]

(b) Salt for the chemical industry can be obtained by solution mining.

(i) Describe how salt is obtained by solution mining.

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.....  
..... [2]

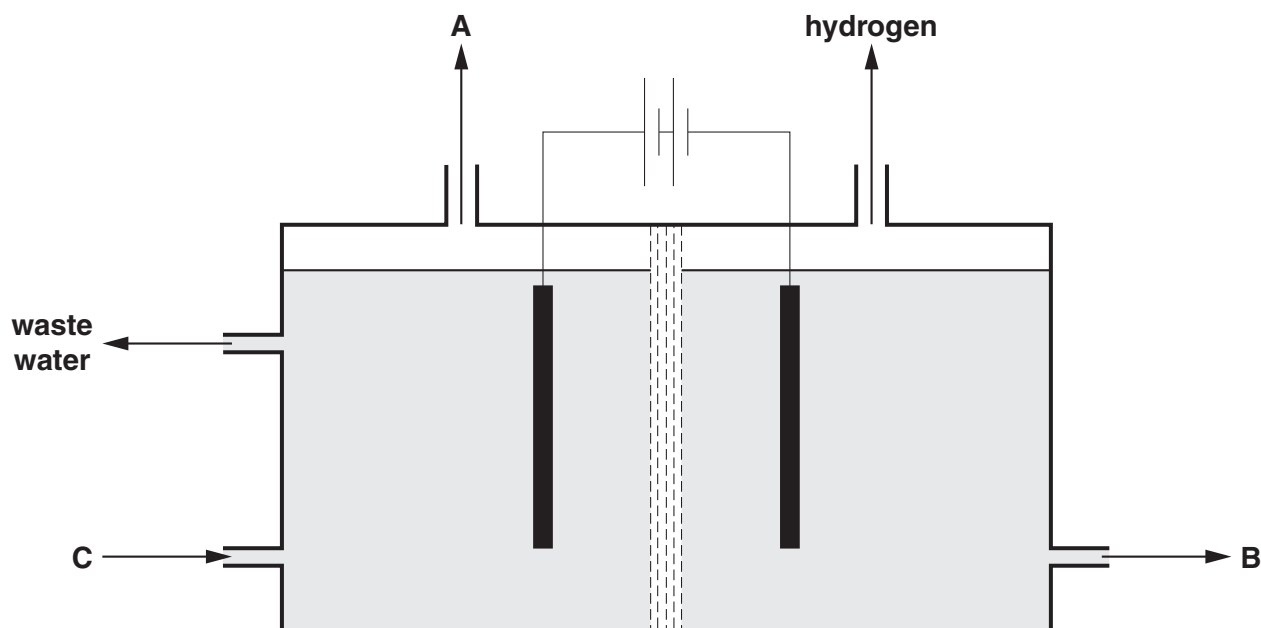
(ii) Describe and explain an environmental problem that can occur as a result of solution mining.

.....  
.....  
..... [2]



(iii) By passing electricity through salt solution, three useful products can be made.

The diagram shows the electrolysis cell used for this process.



The labels **A**, **B** and **C** represent three chemicals involved in this process.

Complete the table to show the names of each of these three chemicals.

Choose words from this list.

sodium carbonate

sodium chloride

chlorine

nitrogen

sodium hydroxide

Label	Chemical
<b>A</b>	
<b>B</b>	
<b>C</b>	

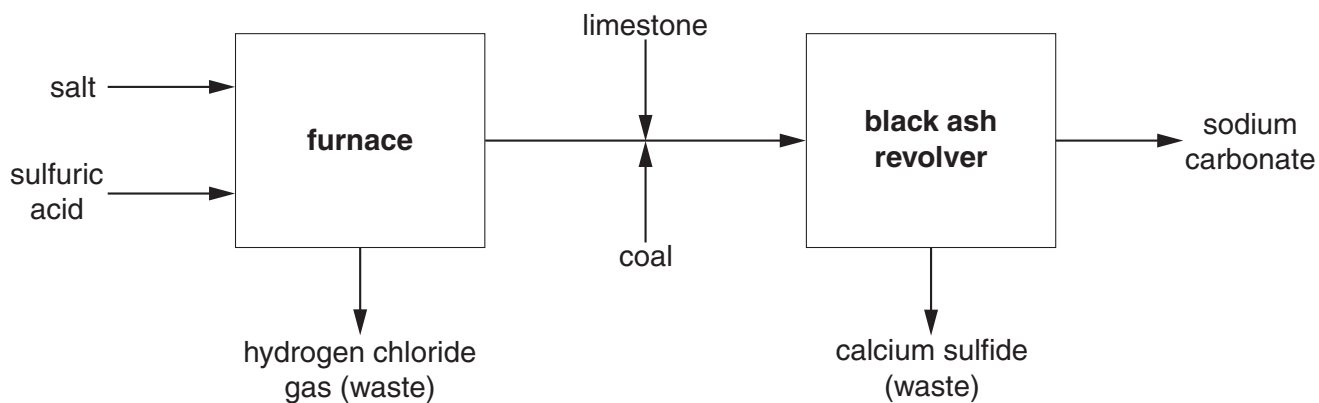
[2]

(c) One industrial use of salt is to make the alkali, sodium carbonate.

There are large underground deposits of salt in the North West of England.

This resulted in the development of an industry to make sodium carbonate.

The diagram below shows the process used to produce sodium carbonate.



Use the diagram to suggest **two** other reasons why the alkali industry developed in the north west of England.

- 1 .....
- .....
- 2 .....
- ..... [2]

[Total: 10]

**END OF QUESTION PAPER**

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